Space Weather Technical Forecast

Issued on Monday, 15 July 2024 at 13:13 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: M-Class flares Likely (R1-R2 radio blackouts).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate, with an M2.7 flare at 15/0937 UTC from AR3738. There are now up to thirteen sunspot regions on the visible disc. The largest and most complex region remains AR3738, now approaching the western limb. Its overall size has started to decrease, having lost a few peripheral spots, but it remains magnetically complex. Another large region is AR3751, which recently emerged from the eastern limb. It consists of two spots with penumbra pretty much coaligned east-west, with several intermediate spots in-between. AR3743 near the centre disc continues to see a proliferation of intermediate spots and a small delta spot is now confirmed on the leading group of AR3744, in the northeast quadrant. The other regions are considered to be relatively small and simple, including the new regions that have recently developed on the northwest quadrant. A new region is also emerging on the northeast quadrant but its analysis is incomplete due to the sharp angular view.

Despite the number and scale of solar flares, no Earth-directed CMEs have been observed. Some dimming was observed near AR3738 following the recent M2.7 flare, potentially indicating the release of a CME but we will only find out once Coronagraph imagery becomes sufficiently available. Another CME may have been spewed from the new sunspot region currently emerging on the northeast limb. None of these affect the forecast.

Solar Wind / Geomagnetic Activity: The solar wind signal comprised variations on a slow regime, as measured by ACE at L1. The solar wind speed was at background levels between 270 and 320km/s. The solar wind density was also within long-term background in single figures ppcc, while the IMF was at background with a peak of 6nT and a north-south variation of +4 and -3nT. The phi angle spent roughly equal periods in positive and negative territory.
The net result of the above solar wind measures was for provisionally Quiet Kp indices throughout.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 remained at Background, despite numerous large flares from a potentially prone location (AR3738 nearing the western solar horizon).

High energy electron flux (greater than 2MeV) observed by GOES16 was at Normal Background. The 24-hour fluence was below Active, with 1.46e6 integrated pfu observed at 15/0001UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Further M-class flares are Likely with a slight chance of further X-class flares. The most likely candidate remains AR3738 but isolated flares are also possible from elsewhere on the disc. This risk abates slightly after midweek with the main sunspot group leaving the facing side of the Sun.

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Met Office Space Weather Technical Forecast

Solar Wind /Geomagnetic Activity: No Earth-directed CMEs feature in the forecast. With no immediate source of solar wind enhancements, geomagnetic activity is expected to be mostly Quiet from Day 1 to Day 3 but Unsettled to perhaps Active with a slight chance of a G1/Minor Storm interval on Day 4 (18 July).

Energetic Particles / Solar Radiation: High energy proton flux is expected to remain at Background levels, but with a Slight Chance of rising in response to any notable flares, mainly from AR3738.

High energy electron flux is expected to persist at Normal Background levels for much of the period, with any fast wind from CH54 considered to be too late to have any impact on 24-hour fluence in this four-day forecast period.

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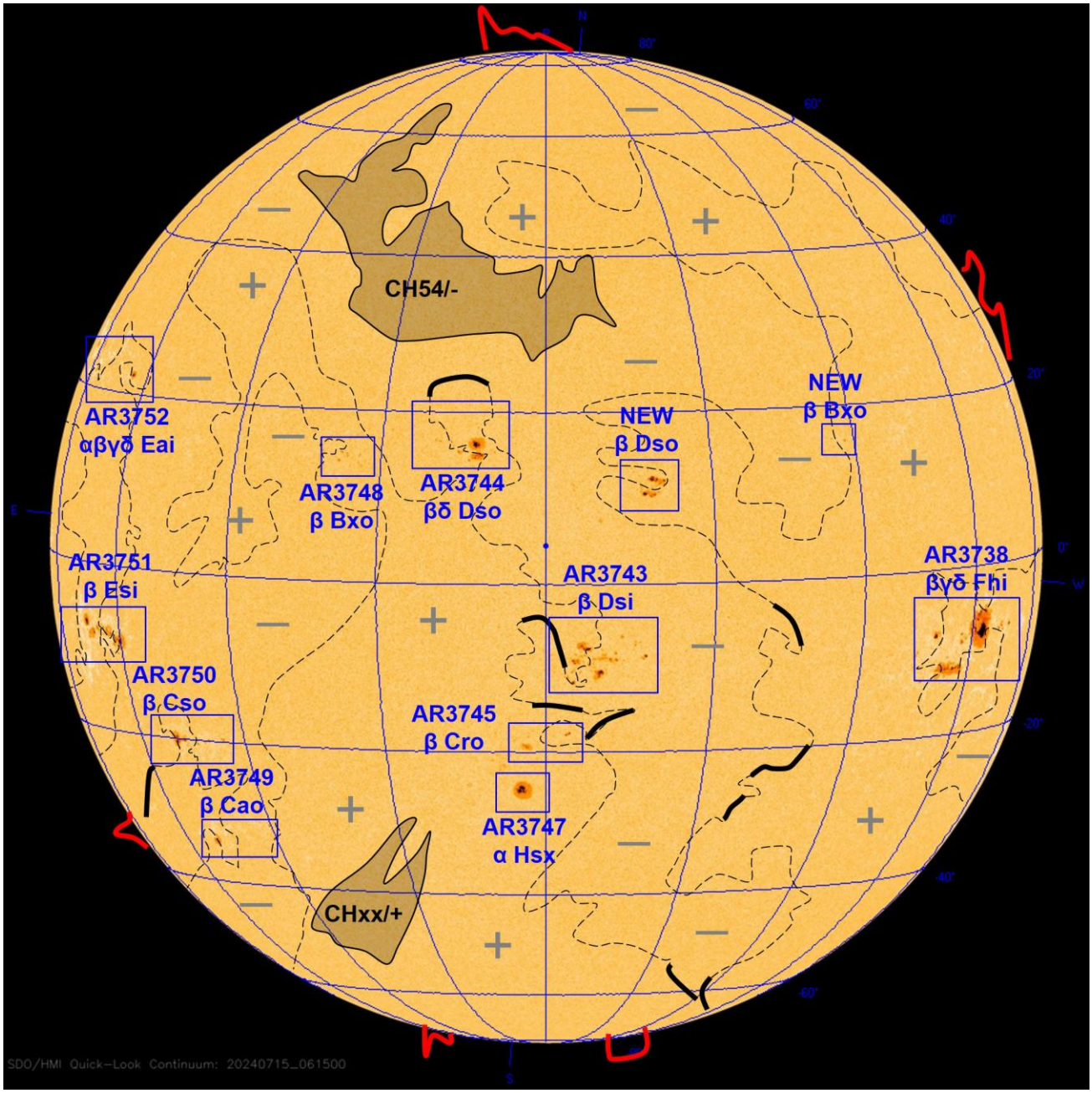
Figure 1. Solar Analysis Valid 15/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No CMEs feature in the forecast.

There were two potential solar wind enhancements in the forecast but the fast wind from CH52/+ is clearly overdue and can now be dismissed. The second fast wind (from CH54/-) is something of an unknown quantity as, although it was present on the last rotation, it caused no notable effect on geomagnetic activity.

Indeed, fast speed streams originating from negative coronal holes tend to interact more strongly with the Earth's magnetosphere during the Spring solstice so although a glance from the southern edge of a CIR remains possible Thursday 18 July, the chance of a G1/Minor Storm interval is considered slim.

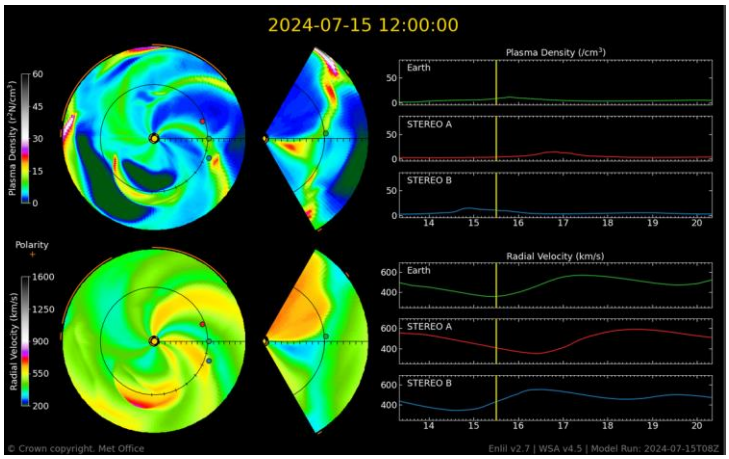
MOSWOC Enlil is almost anti-phase compared to expectations and very likely overstated in terms of magnitude. All things considered, geomagnetic activity is expected to be mostly Quiet from Day 1 to Day 3 but Unsettled to perhaps Active with a slight chance of a G1/Minor Storm interval on Day 4 (18 July).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	1	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

NIL

Figure 2: MOSWOC Enlil, considered to over-estimate the solar wind speed at Earth



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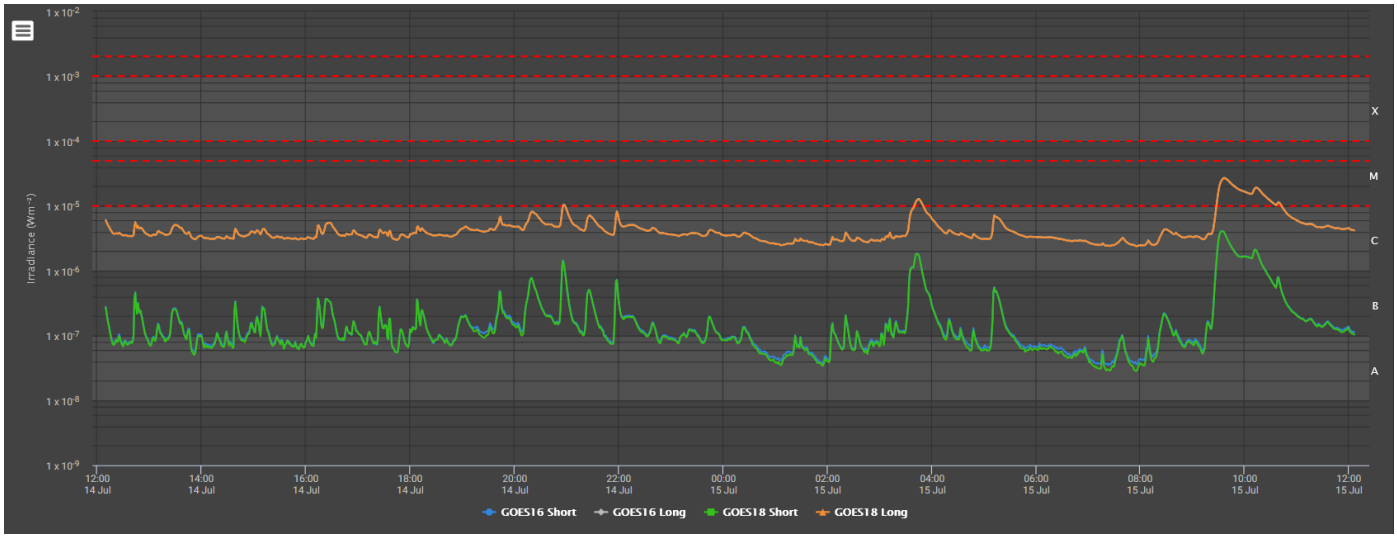
Radio Blackouts - X-Ray Flares:
Current activity is dominated by AR3738 in the southwestern solar quadrant, and is proving episodic - presumably tied to minor changes in the configuration of spots within the group, as the overall class has been little changed in recent days.

Concerning the balance of regions and trends in activity, far-side helioseismographs show a steady cadence of echoes that may hint at several arriving sunspot regions in the period, perhaps including the one responsible for a far-sided partial halo CME seen around the middle of last UTC week. On the front side, the only notable sunspot that is expected to depart in the four days is also the largest and most active, with AR3738 due to progressively rotate off on Thursday 18 July.

The certainty of AR3738's passing versus the speculative nature of any arrivals over the eastern limb is the rationale for the slight downturn in risk on day four, however given the sunspot region's size, it may well be two full UTC days before the risk settles at a new lower level.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**R1-R2 M Class**	Yes	70	70	70	60
Very Active	**R3 to R5 X Class**	No	10	10	10	5

Figure 3: Latest X-Ray flare activity, as observed at GOES16 & 18



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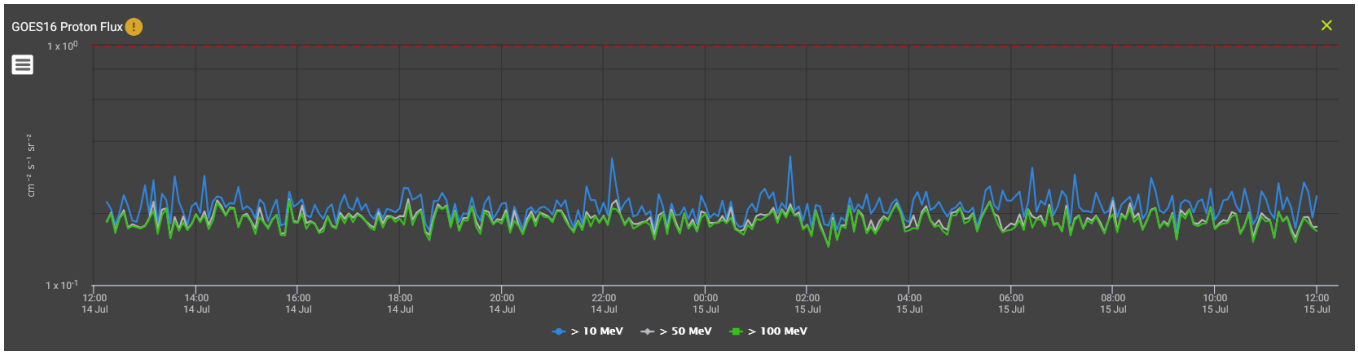
Solar Radiation Storms - (High Energy Protons):
High energy proton flux at GOES18 is at Background, and has remained unmoved by recent large X-ray flare activity from AR3738 in particular. Despite this recent lack of any enhancement, there is considered a daily Slight Chance of exceeding the S1/Minor radiation storm threshold should any further significant flares occur, these perhaps most likely from AR3738. This risk should begin to fall later in the UTC week as the pre-eminent sunspot AR3738 begins to rotate onto the far side and its contribution decreases.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	15	15	15	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: Latest Proton Flux, as observed at GOES16



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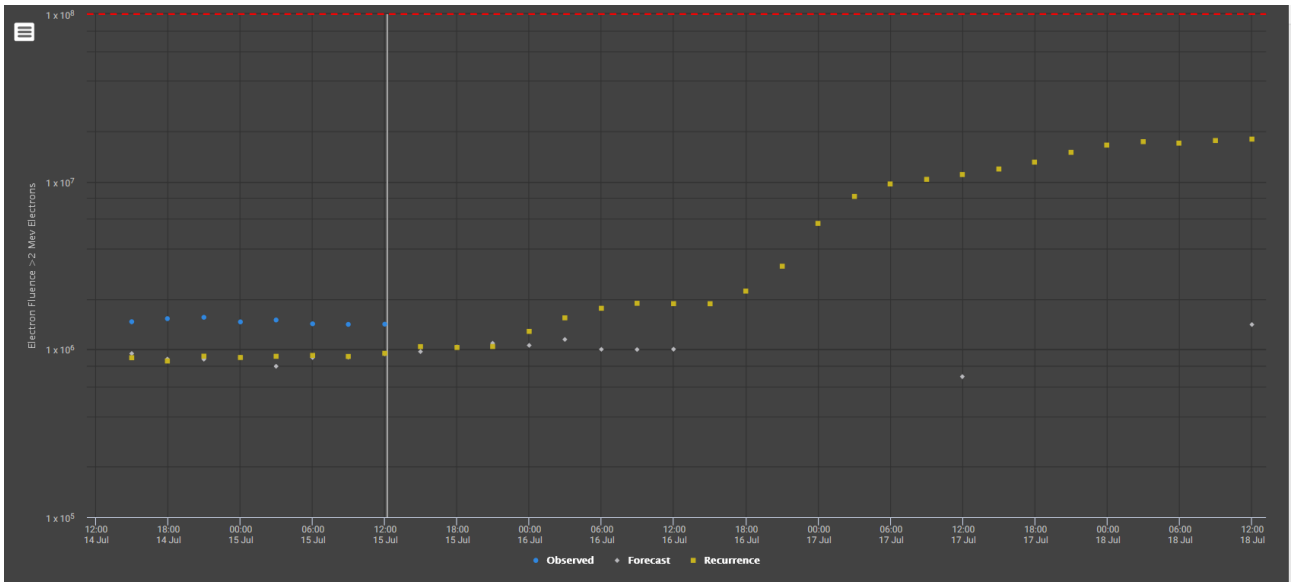
High Energy Electrons Event (≥ 2MeV):
Having now dismissed any influence from CH52/+ and with no immediate sources of fast wind enhancements, the High energy electron flux is expected to remain at low / background levels. This may change at the onset of the fast wind originating from CH54/-, however this is due on or around Day 4 (18 July) and therefore too late for any eventual uptick in fluence (more likely on Day 5 - 19 July).

For what it's worth, recent MOSWOC REFM runs are considered to be offering reasonable guidance in their continuing flat forecast trend, although in this case its utility is limited as there are no expected mechanisms to alter the current sub-Active conditions.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	5
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: Latest MOSWOC REFM output, the forecast remaining well below the Active threshold



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